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CONSEIL PERMANENT INTERNATIONAL
POUR L'EXPLORATION DE LA MER

PUBLICATIONS DE CIRCONSTANCE

N° 29

ON THE DISTRIBUTION AND THE MIGRATIONS OF *MUGGIAEA ATLANTICA*, CUNNINGHAM, IN THE ENGLISH CHANNEL, THE IRISH SEA, AND OFF THE SOUTH AND WEST COASTS OF IRELAND, IN 1904

BY

LEWIS HENRY GOUGH, PH. D., PLYMOUTH
ASSISTANT NATURALIST TO THE MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

WITH 3 CHARTS AND 2 FIGURES IN THE TEXT

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The following paper has been written chiefly in order to draw the attention of plankton-workers to *Muggiaea atlantica*, CUNNINGHAM, as the study of the migrations and distribution of this species gives results which well repay the time spent on it. *Muggiaea* is specially favourable for this purpose, as its size precludes the possibility of its being overlooked in any sample in which it is to be found, and yet it seems small enough to be taken by the nets with certainty when present.

Conclusions concerning the direction and speed of currents indicated by the migration of any plankton organism which can live at the surface are always more or less liable to confuse the effect of wind-drift at the surface of the water with the larger currents themselves. A thin layer of the surface water driven by the wind would be quite sufficient to carry many individuals of the species whose migrations are being studied to places remote from the main current. Then, supposing that the rate of multiplication of the species is great enough, the whole body of the water could be stocked by immigrants from the surface layer, thus obliterating the difference between the plankton of the main-current, and of the places reached by the superficial wind-drift. In the case of *Muggiaea*, the rate of increase is probably very great, as its siphosomes are constantly budding off endoxomes and thus increasing the number of individuals. It is also often found at the surface in British waters.

It is also well within the bounds of possibility that a species whose "birthrate" is high can spread fairly rapidly over a considerable area independently of wind and current, the migration in this case being due to the increase in numbers of individuals alone.

It is necessary to make these preliminary remarks in order to

prevent the possibility of any misunderstanding occurring; thus the advance of *Muggiaea* in the Channel and elsewhere may have been due either to the main-current, or to a merely superficial wind-drift, or to the spreading due to the increase in the number of individuals. There is absolutely no proof, and very little possibility of *Muggiaea atlantica* developing on the spot in our waters from a resting or sedentary stage of any kind whatever.

Before proceeding to the discussion of the migrations of *Muggiaea atlantica* I insert the following definitions of the genus and species.

Haeckel's definition of the genus *Muggiaea* is: "Monophyidae with an angular pyramidal nectophore, and a complete infundibular hydroecium on its ventral side. Bracts spathiform or conical, with a deep ventral groove, a bevelled basal face, and a simple ovate phyllocyst". (Report on Siphonophorae collected by H. M. S. Challenger during the years 1873—1876, p. 136.)

According to Cunningham (Journal of the Marine Biological Association, 1891—92, p. 212—214), *Muggiaea atlantica* can be distinguished from the other species by the following characters. The edges of the nectophore are smooth, the hydroecium extends to one third the height of the nectosac, the upper end of the somatocyst is above (or about on a level with) the apex of the nectosac. An oleocyst is present at the top of the somatocyst. (See the figures on p. 5.)

It is now proposed to discuss all the procurable data concerning the distribution and the migrations of *Muggiaea atlantica* in English and Irish waters during the year 1904, as they seem within the limits mentioned to afford evidence as to the direction of the currents during that year. *Muggiaea atlantica* differed in its distribution from most other plankton species in 1904. Coming into the Channel from the South West it could be traced on its way up Channel as far as Portland, past the Scillies into the Irish Sea, along the South Coast of Ireland and as far as Galway Bay on the West of Ireland. Its movement along the Irish Coast especially seems to be important, as *Muggiaea* there appears to have moved in the opposite direction to that which would have been expected.

The records upon which this paper is based have been collected from several sets of samples, which differ among themselves especially in the frequency with which they have been taken at different places. A complete list (A) of the samples with the dates of collection will be found on pages 9—11. In that on p. 12—13 (B) will be found a fairly complete list of the published records, besides a few earlier unpublished ones.

Among the most important samples were those taken on the Quarterly Hydrographical Cruises; these are unfortunately rather far

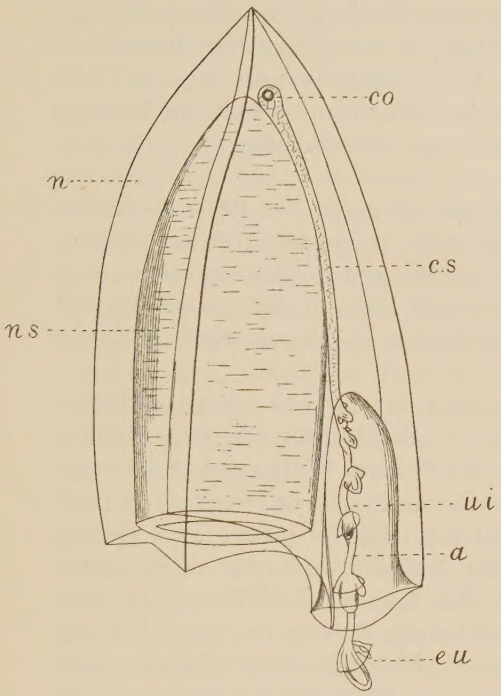


Fig. 1 *Muggiaea atlantica*, seen from the right side

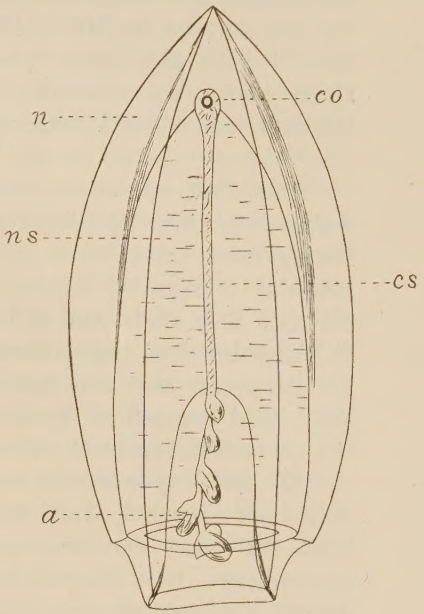


Fig. 2 The same from the ventral side

a, siphosome or common tubular stem, bearing *eu*, cormidia, or groups of zooids at intervals; *co*, oleocyst; *cs*, somatocyst; *n*, nectocalyx; *ns*, nectosac or cavity of the nectocalyx; *ui*, hydroecium, cavity from the apex of which the siphosome depends.

Figures 1 and 2 are from the original copper-plate with which Cunningham's paper was illustrated.

apart in time. Samples were also collected fortnightly at various places on the Coasts of Ireland and England; on the South Coast of Ireland at Fastnet Lighthouse and Coningbeg Lightship; on the East Coast of Ireland at South Arklow and Skulmartin Lightships, the latter set giving only negative results; on the West Coast of England and Wales at Cardigan Bay and Bahama Bank Lightships, the latter also giving negative results; on the South Coast of England samples were taken at Sevenstones, Shambles, Owers and Varne Lightships, of which the last two also gave negative results. Townettings taken at Plymouth were also examined every week, and in addition a number of samples were taken on a mackerel fishing-boat at irregular intervals and at different places in the Channel. In order to get as complete a list as possible, the jelly-fishes taken in 1904 on the quarterly cruises of the investigation steamer Helga of the Fisheries Branch of the Department of Agriculture and Technical Instruction

for Ireland were examined, having been kindly placed at my disposal for this purpose by Mr. E. W. L. Holt, to whom my best thanks are due. I have also been fortunate in obtaining permission from Miss Delap to use her records of *Muggiaea atlantica*, Cunn. from Valentia Harbour, for which I wish to express my best thanks.

The first specimen of *Muggiaea* observed in 1904 in British waters was taken at Shambles Lightship on January 19th, no samples having been taken there earlier in the year. This specimen was probably a remnant of the large shoal seen in November 1903 at Stations E 19, E 18 and E 17. No further specimens were obtained at Shambles until September.

Muggiaea was not again observed in the area under consideration until the end of April, so that it would seem probable that the species had disappeared entirely in the Channel by the end of January.

On the May quarterly cruise *Muggiaea* was observed at Station E 2, April 27th, E 3, April 28th, and E 8, May 3rd (Chart I). I do not think that there can be any doubt, especially in view of the later observations, that the presence of this species at these stations was due to a recent inflow of water containing it from the Bay of Biscay past Ushant. It is interesting to note that this flow of water must have passed fairly close to the shore at Ushant, and that it could not have been very wide, as no specimens were observed at E 4. It might also be mentioned here, that *Muggiaea atlantica* was never observed at E 4 in 1904. Its distribution at the beginning of May 1904 is represented by the crossed lines on Chart I.

During the next few weeks it continued spreading northwards, being observed 18 miles S. W. of the Eddystone on May 22nd, and 14 miles S. of the Eddystone on June 3rd. Besides drifting in a northerly direction, it was also moving towards the North West, reaching Sevenstones Lightship between May 30th and June 15th, the first record being made on June 15th. It was regularly observed at Sevenstones every fortnight until December 8th. The distribution during the end of May and in June is represented by the crossed and vertical lines on Chart I.

The advance of *Muggiaea atlantica* still continued towards the North, it being next observed 42 miles S. of Plymouth on June 21st, and 20 miles S. S. W. of Plymouth on July 3rd. On July 6th it was taken at Plymouth for the first time in 1904, and continued to be observed in nearly every sample from the Harbour until the end of November. The horizontal lines on Chart I indicate the advance made since June, the shoal now covering in all probability the whole of the areas marked by lines. It will be seen that I have carried the curve for this period on Chart I far to the North of Sevenstones.

That I am perfectly justified in doing so will become apparent when its distribution in August is taken into consideration.

The quarterly cruise in August gives an opportunity of observing most of the limits of the vast shoal of *Muggiaea atlantica*, whose northern boundaries alone could be imperfectly traced during the two preceding months. The inflow from the Bay of Biscay was probably still continuing, as is suggested by the presence of the siphonophores at Station E 3 on August 13th. The area occupied by them had grown much larger than it was in May, the increase in the area possibly giving an approximate idea of the quantity of water that had flowed past Ushant during the three months that had just elapsed. We now find, instead of the relatively small patch covering E 2, E 3 and E 8 in May, a two branched area whose extreme eastern limit reached to near 2° W at E 11, whose northern limit was in the Irish Sea near Cardigan Bay, and whose western boundary passes to the East of Station E 5 and probably close to the Scillies. The August records were from the following places: E 3, August 13th; E 2, August 12th; E 1, August 12th; Plymouth, August 4th, 11th, 19th, 24th; E 20, August 3rd; E 19, August 10th; E 9, August 3rd; E 17, August 4th; 50°8′ N. 2°8′ W., August 7th; E 11, August 7th; E 6, August 16th; Seven-stones, August 12th and 29th; E 7, August 16th; Cardigan Bay, August 26th; It must have arrived at Cardigan Bay between August 12th and 26th. The crossed lines on Chart II show the probable distribution of *Muggiaea* in August 1904.

Like so many other oceanic species, *Muggiaea* does not seem able to pass the Isle of Wight — Cherbourg line, and its most easterly distribution was reached at E 11. It will be seen that I have connected the Channel *Muggiaea* with the Cardigan Bay patch on Chart II. This possibly requires some explanation. In the first place, the Cardigan Bay patch can hardly have come from the North of the Irish Sea, as *Muggiaea atlantica* was never taken at Skulmartin or Bahama Bank Lightships in 1904. It certainly would have had to pass Skulmartin if it had entered the Irish Sea from the North. It might also be asked whether it is possible that it belongs to a shoal entering the Irish Sea from the South West, and independent of the Channel swarm. This is also improbable, as a swarm coming from the South West would be likely to pass Coningbeg and probably also Fastnet before arriving at Cardigan Bay. It will be seen in the following that the *Muggiaea* shoals in reaching those positions always appeared first in the East and advanced step by step to the West.

In September the eastern portion of the shoal shifted its position somewhat, so that it then reached as far North as Shambles Lightship, being first recorded there on September 11th. After this no change could be observed in the Channel for some time. This will

become apparent on comparing those portions of the curves (Charts II and III) for September, October and November which run on the South Coast of England. The records of this part of the shoal are: Shambles, September 11th, 26th, October 10th, 24th, November 10th, 24th; Plymouth, September 1st, 6th, 14th, 21st, 26th, November 1st, 10th, 22nd, 30th; Sevenstones, September 13th, 26th, October 11th, 27th, November 11th, 24th. However the western portion of the shoal was changing its position fairly rapidly. We have already seen that it had reached Cardigan Bay by August 26th; it was again observed there on September 9th and 25th, but Cardigan Bay was no longer the North Western limit of the shoal, for samples taken on September 9th and 10th show that it had reached South Arklow and Coningbeg (see Chart II). At South Arklow it was again observed on September 24th. After this date it left Cardigan Bay and South Arklow, being perhaps driven southwards from there by a southerly drift out of the Irish Sea. Having reached Coningbeg on September 10th, it was again observed there on the 24th, by which date it also reached Fastnet. Three days later, on September 27th, Miss Delap took specimens of *Muggiaea atlantica* at Valentia. This was probably the actual date of their arrival there, townettings taken the day before (September 26th) and on September 10th and 21st having failed to reveal their presence. We have thus seen that the progressive appearance from East to West of *Muggiaea* from Cardigan Bay to Valentia can be easily followed, the dates being Cardigan Bay on (or before) August 26th. South Arklow and Coningbeg on (or before) September 10th (9th), Fastnet on (or before) September 24th, Valentia on September 27th, It must not however be thought that the entire shoal travelled from Cardigan Bay to Fastnet etc. The *Muggiaea* appearing at each of the places mentioned were probably outlying members of a vast shoal to be found somewhere between the Scillies and Ireland, and continuous with the English Channel shoal.

No further changes were observed in the Western portion of the shoal in October. It was recorded from Coningbeg, October 9th, 25th; Fastnet, October 10th, 25th; Valentia, October 19th, 31st. Its further drift was now to the North of Valentia, and cannot be traced step by step owing to the almost entire absence of records or of townettings.

The results obtained from the material taken on the November cruise predict the coming breaking up and disappearance of the shoal. No *Muggiaea* were observed at Stations E 2 or E 3, thus making it appear probable that the drift of water containing this species has ceased to flow in from the Bay of Biscay. This fresh drift of water has almost separated the shoal into two parts, the narrow band connecting which would lie near 5° W. A month later the shoal was

probably entirely divided into two at this point, evidence for which will be given below.

The records for November were E 1, October 31st; midway between E 1 and E 2, October 31st; Plymouth, November 1st, 10th, 22nd, 30th; E 20, November 10th; E 8, November 11th; E 19, November 10th; E 9, November 12th; E 18, November 11th; E 17, November 12th; Shambles, November 8th, 24th; E 7, November 4th; E 5, November 3rd; Sevenstones, November 11th, 24th; E 6, November 3rd; Coningbeg, November 8th, 23rd; Fastnet, November 8th, 24th; Valentia, November 5th, 16th, 18th; 8 miles E. of Eeragh Island Light, Galway Bay, November 23rd. The whole of the areas marked by lines on Chart III represent the distribution of *Muggiaea* in October and November.

In December the drift of water not containing *Muggiaea atlantica* had pushed right across the Channel, and reaching Plymouth made its presence known by the entire disappearance of *Muggiaea* from the plankton. The Eastern portion of the shoal was still observed in samples from Shambles, December 8th and 24th. The Western shoal was only observed at Sevenstones and Coningbeg. At Sevenstones it was solely recorded on December 8th, having drifted away before the end of the month. At Coningbeg it was observed on December 7th and 23rd. The horizontal lines on Chart III represent the probable distribution in December 1904; in drawing them the distribution in February 1905 has been considered.

It will thus be seen that, stated briefly, a shoal of *Muggiaea atlantica* entered the Channel from the South West passing Ushant. Spreading northwards it divided into two arms, one of which extended eastwards as far as station E 11 and Portland; the other arm rounded Land's End, reaching the Irish Sea, and following the South Coast of Ireland westwards as far as Fastnet. Then turning northwards along the West Coast of Ireland it passed Valentia and was even observed in Galway Bay. A fresh current setting in past Ushant at the end of October appeared to divide the original shoal into two portions, which were seen for the last time in 1904 off Portland and Coningbeg.

A. List of samples collected in 1904 and examined in connexion with this paper.

(The dates printed in ordinary type denote that no *Muggiaea* was observed on that day; the dates of the records of *Muggiaea* are printed in black type.)

Varne Lightship. I, 19; II, 1, 16; III, 3, 17; IV, 2, 15, 30; V, 16, 31; VI, 14, 27; VII, 13, 29; VIII, 11, 26; IX, 9, 26; X, 11, 24; XI, 7, 25; XII, 9, 22.

Owers Lightship. I, 6, 19; II, 1, 15; III, 3, 18; IV, 2, 16, 29; V, 14, 29; VI, 13, 27; VII, 13, 28; VIII, 15; IX, 2, 16; X, 9, 24; XI, 7, 23; XII, 7.

Shambles Lightship. **I. 19**: II, 3, 19; III, 3, 18; IV, **1, 16**; V, 2, 14, 31; VI, 14, 30; VII, 15, 28; VIII, 13, 28; **IX. II. 26**: **X. 10. 24**: **XI. 10. 24**; XII. 8. 24.

Sevenstones Lightship. 1, 19; II, 3, 17; III, 3, 18; IV, 5, 16; V, 2, 16, 30, **VI. 15. 30**; **VII. 14. 28**; **VIII. 12. 29**; **IX. 13. 26**; **X. II. 27**: **XI. II. 24**; **XII. 8.** 23.

Cardigan Bay Lightship. II, 1, 16; III, 2, 17; IV, 1, 16, 30; V, 16, 30; VI, 14, 27; VII, 13, 27; VIII, 12, **26**; **IX. 9, 25**; X, 10, 25; XI, 7, 24; XII 7, 24.

Bahama Bank Lightship. II, 3, 18; III, 4, 18; IV, 2, 16, 30; V, 16, 31; VI, 15, 29; VII, 14, 27; VIII, 13, 27; IX, 10, 27; X, 10, 25; XI, 10, 24; XII, 8, 24.

Skulmartin Lightship. I, 22; II, 3, 16; III, 3, 18, 31; IV, 15, 30; V, 16, 30; VI, 15, 28; VII, 13, 28; VIII, 12, 27; IX, 12, 26; X, 10, 25; XI, 8, 24; XII, 8, 23.

South Arklow Lightship. II, 1, 17; III, 3, 18; IV, 2, 16, 29; V, 16, 29; VI, 14; VII, 13, 27; VIII, 12, 27; **IX, 9, 24**; X, 10, 26; XI, 7, 28; XII, 7, 22.

Coningbeg Lightship. I, 19; II, 1, 16; III, 2, 17, 31; IV, 15, 30; V, 15, 29; VI, 13, 27; VII, 13, 27; VIII, 12, 26; **IX. 10. 24**: **X, 9, 25**; **XI. 8. 23**; **XII. 7. 23.**

Fastnet Lightship. II, 3, 18; III, 2, 22; IV, 20, 30; V, 14, 31; VI, 17 29; VII, 12, 29; VIII, 12, 26; IX, 9, **24**; **X. 10, 25**; **XI.** 8, **24**; XII, 24.

Plymouth Sound, West Channel. I, 8, 12, 17, 28; II, 2, 3, 10, 15, 23; III, 1, 8, 14, 24; IV, 8, 11, 19, 25; V, 4, 8, 17, 25; VI, 2, 8, 14, 22, 27; **VII. 6, 13, 21**, 27; **VIII. 4, II. 19, 24**; **IX. 1, 6, 14, 21. 28**: **X. 5. 15. 21. 26**; **XI. 1. 10.** 15, **22**, 30; XII. 7, 14, 20, 31.

Valentia (with Miss Delap's permission). III, **25**; IV, 26; V, 3, 9, 10, 12, 16, 19, 24, 31; VI, 2, 4, 7, 10, 18, 20, 21, 23, 29, 30; VII, 7, 8, 9, 11, 12, 14, 19, 21, 23, 26, 27, 28; VIII, 5, 6, 9, 10, 12, 16, 18, 20, 24, 26, 30; IX, 3, 10, 21, 26, **27, 28**, 30; **X. 19.** 26, 31· **XI, 5, 16, 18.**

23 miles S. of Plymouth Mewstone, III, 5.
11 — S. by W. of Eddystone, III, 10.
10 — S. S. W. of Eddystone, III, 14.
10 — S. E. by E. of Lizard, IV, 17.
10 — S. by E. of Lizard, IV, 22.
6 — S. of Gribbin, IV, 24.
20 — S. S. W. of Eddystone, IV, 29.
20 — S. W. of Eddystone, V, 5.
10 — S. W. of Eddystone, V, 8.
26 — S. E. of Plymouth, 5, 13.
22 — S. of Plymouth, V, 20.

18 miles S. W. of Eddystone, **V**, **22**.
20 — S. S. W. of Plymouth, V, 30, **VII**, **3**.
14 — S. of Eddystone, **VI**, **3**.
12 — S. S. W. of Eddystone, VI, 4.
26 — S. S. W. of Plymouth, VI, 11.
42 — S. of Plymouth, **VI**, **21**.
20 — S. S. W. of Plymouth Harbour, **VII**, **3**.

Station E 1. II, 16; IV, 27; **VIII**, **12**; **X**, **31**.
E 2. II, 19; **IV**, **27**; **VIII**, **12**; XI, 1.
— E 3. II, 20; **IV**, **28**; **VIII**, **13**; XI, 2.
— E 4. II, 20; IV, 28; VIII, 13; XI, 2.
— E 5. II, 21; IV, 29; VIII, 14; **XI**, **3**.
— E 6. II, 23; IV, 29; **VIII**, **16**; **XI**, **3**.
— E 7. II, 23; IV, 30; **VIII**, **16**; **XI**, **4**.
— E 8. **V**, **3**; VIII, 3; **XI**, **11**.
— E 9. V, 3; **VIII**, **3**; **XI**, **12**.
— E 10. II, 28; V, 4; VIII, 5; XI, 12.
— E 11. II, 28; V, 4; **VIII**, **7**; XI, 12.
— E 12. II, 28; V, 5; VIII, 8; XI, 13.
— E 13. II, 29; V, 5; VIII, 8; XI, 13.
— E 14. II, 29; V, 5; VIII, 8; XI, 13.
— E 15. V, 4; XI, 12.
— E 16. II, 27; V, 4; VIII, 4.
— E 17. II, 26; V, 4; **VIII**, **4**; **XI**, **12**.
— E 18. II, 26; V, 4; VIII, 4; **XI**, **11**.
— E 19. II, 25; V, 3; **VIII**. **10**; **XI**, **10**.
— E 20. II, 25; V, 3; **VIII**, **3**; **XI**, **10**.
— E 21. II, 29; V, 5; VIII, 8; XI, 13.
— E 22. III, 1; V, 5; VIII, 9; XI, 13.
— E 24. II, 29; V, 5; VIII, 8; XI, 13.

49° 44′ N., 4° 35′ W. VIII, 12; **X**, **31**.
48° 31′ N., 5° 53′ W. VIII, 13; XI, 1.
50° 8′ N., 2° 8′ W. **VIII**. **7**.
50° 13′ N., 1° 14½′ W. VIII, 8; XI, 13.
50° 27′ N., 1° 18′ W. VIII, 8; XI, 13.
50° 17½′ N., 0° 41′ E. VIII, 9.
50° 4′ N., 0° 28′ E. VIII, 9.
50° 4′ N., 0° 18′ E. VIII, 9.
48° 46¾′ N., 6° 35¾′ W. XI, 2.
49° 33′ N., 6° 14′ W. XI, 3.
50° 24′ N., 5° 35′ W. **XI**. 3.
49° 11′ N., 5° 32′ W. XI, 4.
8 miles E. of Eeragh Island Light, Galway Bay. **XI**. **24**.

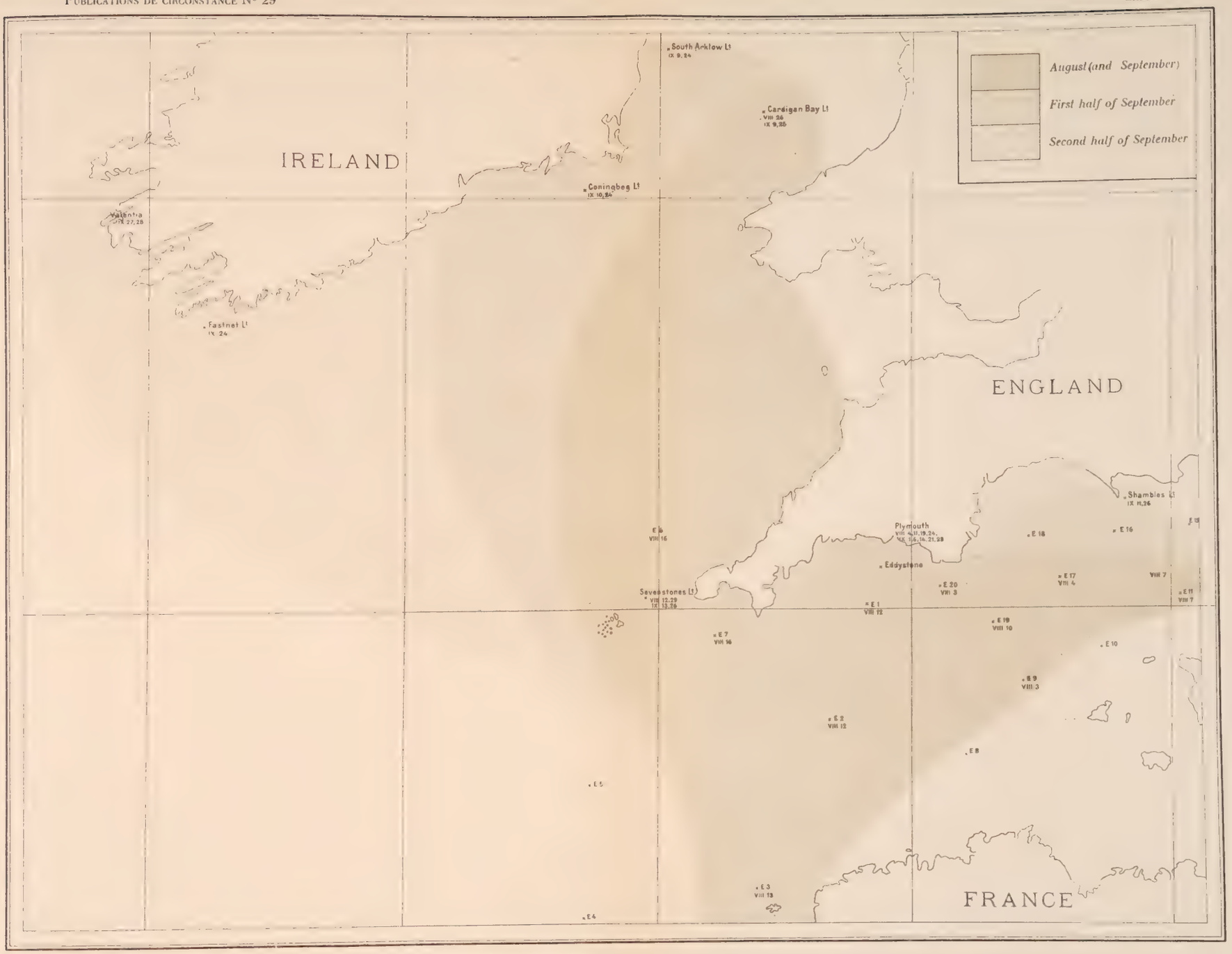
B. List of the published records of *Muggiaea atlantica*, Cunningh. With the addition of a few unpublished records previous to 1904.

Date	Locality	Observer	Reference
1849, VII, 1 & 20, X	Fowey	Peach	29. Annual Report of the R. Institution of Cornwall p. 46—47, pl. 1—2 (as *Diphyes*).
1889, VII	South of Ireland	Bourne	Journal M. B. A. I. 1889—90, p. 321 (as *Muggiaea Kochii*).
1891, IX, 12 to middle of X	Plymouth	Cunningham	Journal M. B. A. II. 1891—92, p. 212 (with original description and figures).
„ , IX, 26	Falmouth	Vallentin	Journal R. Institut. of Cornwall, XI, p. 308.
1892, VIII, 8 to IX, 26	„	„	„ „ „ „ „ XI, p. 313.
„ , VIII, 26 to end of IX	Plymouth	Bles	„ M. B. A. II. 1891—92, p. 342.
1893, II	„	Garstang	„ „ „ „ III. 1893—95, p. 234.
„ , IX	„	Browne	„ „ „ „ IV. 1895—97, p. 170.
„ , II, 7 & 10; V, 30; VI, 9, VII, 15 & 27	Falmouth	Vallentin	„ R. Institution of Cornwall, XII, p. 206—210.
1894, VII, 19; VIII, 7, 20; IX; X, 23	„	„	„ „ „ „ „ XIII, p. 47—49.
1895, VIII, 13 to XII	Plymouth	Hodgson	„ M. B. A. IV. 1895—97, p. 175.
„ , IX	„	Browne	„ „ „ „ „ 1895—97, p. 170.
„ , IX, 5 to X, 23	Falmouth	Vallentin	„ R. Institution of Cornwall, XIII, p. 259.
1896, I to middle of II; IV, 10; V, 8, 9; VII, 24 to end of X	Plymouth	Hodgson	(not published previously).
1896, VII—XI	Valentia	Browne	Proceed. R. Irish Acad. (3). V. p. 693.
1897, IV, VII, X, XI	„	„	„ „ „ „ (3). V. p. 693.
„ , IX	Plymouth	„	Journal M. B. A. V. 1897—99 p. 191.
1898, V, 17; VI, 23; VII, 13, 21, 23, 26 & 28; VIII, 1, 9	Falmouth	Vallentin	Journal R. Institution of Cornwall, XIV, Table.

1899, VII, 4	Plymouth	Browne	Journal R. Institution of Cornwall, p. 122.
„ , VII, 21 to 26	Scillies	„	„ „ „ „ „ p. 122.
„ , IX	Plymouth	M. B. A. Record	(not published previously.)
„ , X, 9, 25; XI, 6, 30	Falmouth	Vallentin	Journal R. Institution of Cornwall, XIV, Table.
1900, VII, 26; VIII, 7, 16, 20; IX, 10; X, 31; XII, 4	„	„	„ „ „ „ „ , XV, Table.
1900, IX	Plymouth	M. B. A. Record	(not published previously.)
„ , VI to X	Valentia	Delap	Report on the Fisheries of Ireland, 1902—03, p. 4.
1901, X to XI	„	„	„ „ „ „ „ „ — p. 4.
„ , IV, 1 & VI, 14	Læsö Rende, N. of Skagen	Johansen & Levinsen	Kgl. Danske Vid. Selsk. Skrift. (6). Naturvid. og Math. Afdel. XII. 3. 1903 p. 282 (as *Muggiaea Kochi*, Chun. (sic) and *Eudoxia Eschscholzi*, Busch)? Perhaps *M. atlantica*.
1902, XII	Plymouth	Gough	(not published previously.)
1903, I, 20, 21; II, 5; X; XI; XII, 2	„	„	Report on the Plankton of the English Channel in 1903. International Fishery Invest. of the M. B. A. Report 1902—03. Table II.
„ , II	E 1	„	Bulletin des Résultats acquis etc. 1902—'03 p. 228.
„ , VIII	E 2, 5, 7, 9, 20	„	„ „ „ „ „ 1903—'04 p. 34—35.
„ , XI	E 1, 4, 7, 17, 18, 19	„	„ „ „ „ „ — p. 104—105.
„ , XI	S 3, 7, 8, 13	Cleve	„ „ „ „ „ — p. 84—85.
1904, II	S 3, 8	„	„ „ „ „ „ — p. 118—119.
„ , V	S 3, 7, 8, 13, 14	„	„ „ „ „ „ — p. 156—157.
„ , V	E 2, 3, 8	Gough	„ „ „ „ „ — p. 182—183.
„ , VIII	S 7, 8, 9, 14	Cleve	„ „ „ „ „ 1904—'05 p. 15.
„ , VIII	E 1, 2, 3, 6, 7, 9; 50° 8′ N., 2°8′ W; E 11, 17, 19, 20	Gough	„ „ „ „ „ — p. 40—41.
„ , XI	S 7, 8, 14	Cleve	„ „ „ „ „ — p. 73.
„ , XI	E 1; 49° 45′ N, 4° 35′ W; E 5, 6, 8, 9, 17, 18, 19, 20	Gough	„ „ „ „ „ — p. 92—93.
1905, II	E 1, 9, 17, 19	„	„ „ „ „ „ — p. 124—125.

[1]) *M. atlantica* was also recorded from R 17 in August 1904. After an examination of the specimen which was kindly forwarded to me by Dr. Breitfuss it is necessary to state, that it did not belong to the genus *Muggiaea*.

DISTRIBUTION OF *MUGGIAEA ATLANTICA*, CUNN. IN 1904



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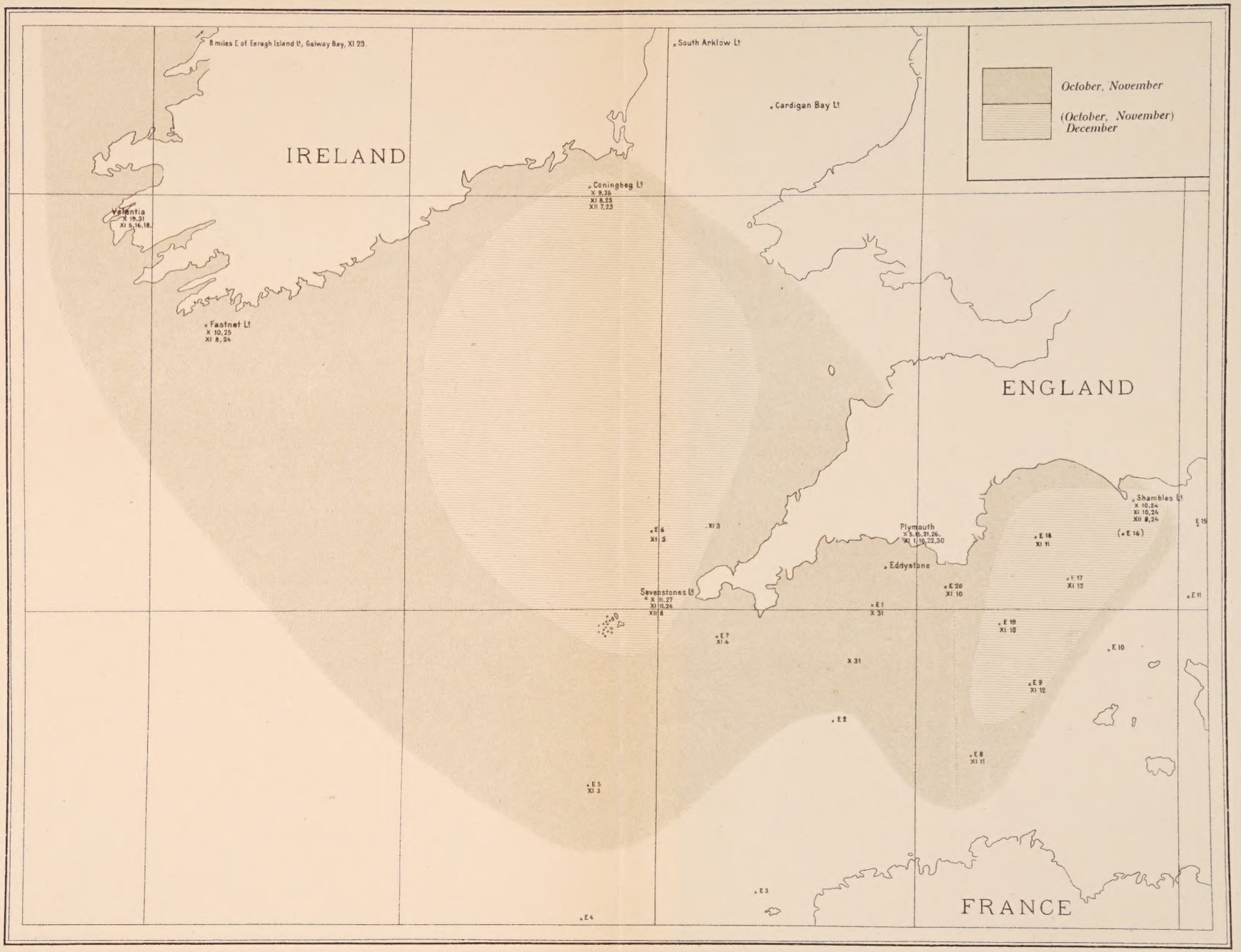

DISTRIBUTION OF *MUGGIAEA ATLANTICA*, CUNN. IN 1904

N° 21. Charles J. J. Fox, On the Determination of the Atmospheric Gases Dissolved in Sea-Water. (Communications du Laboratoire central à Christiania N° 1.) 24 p. 1 pl. 4 Fig. March 1905. Kr. 1.

N° 22. D. Damas, Notes biologiques sur les Copépodes de la mer norvégienne. 24 p. 1 carte. Avril 1905. Kr. 1.

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N° 24—26. Zusammen 20 S. 4 Taf. Juli 1905. Kr. 1.50.

N° 27. V. Walfrid Ekman, An Apparatus for the Collection of Bottom-Samples. (Communications du Laboratoire central à Christiania N° 4.) 6 p. 5 fig. August 1905. Kr. 0.50.

N° 28. Bericht über die Anstalten zur Vermehrung des Lachses und der Meerforellen in den Flüssen der Ostsee. Im Auftrage der Kommission C 1, unter Mitwirkung von Prof. Dr. O. von Grimm (Russland), von dem deutschen Seefischerei-Verein (General-Sekretär Prof. Dr. H. Henking) (Deutschland) und von Fischereikonsulent Chr. Levinsen (Dänemark), bearbeitet von dem Geschäftsführer Dr. Fil. Trybom. 34 S. November 1905. Kr. 0.75.

N° 30. Rolf J. Witting, Kurze Beschreibung eines elektrisch registrierenden Strommessers. 8 S. Textfig.

N° 31. — — Etliches über Strommessung. 11 S.

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